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BATTLE COMMAND SOFTWARE: MEETING THE COMMANDER'S NEEDS?

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ABSTRACT

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Over the past twenty-plus years, the Army has invested heavily in automating its command and control information systems. The automation of this information, known as digitizing the battlefield, is currently deployed worldwide, supporting commanders and staff at the tactical, operational, strategic level. Battle command systems are also unable to provide situational understanding to the fidelity required for a hostile and adaptive enemy the United States faces today. A different capability set is needed to support the commander's ability to balance the art and science of battle command to achieve situational understanding. These deployed information systems have significant interoperability flaws that inhibit effective command and control. The intent of this paper is to analyze Army Battle Command Systems capability and prominent parallel battle command software developments utilizing Department of Defense Net-Centric enablers as well as Joint and Army Battle Command doctrine and present suggestions for future development effort.

BATTLE COMMAND SOFTWARE: MEETING THE COMMANDER'S NEEDS?

Soon after America prosecuted one of the most decisive land combat operations in history, writing in the aftermath of Operation DESERT STORM focused on the tremendous capability that technology would bring to future warfare. In 1993, Chief of Staff of the Army (CSA) General Gordon R. Sullivan drew from the past to forge a vision for the future. "For two decades the Army has pioneered information-based systems. Now it is evident that information and knowledge based systems, organizations, and operations will change fundamentally the way the Army fights."[1]

General Sullivan asserted that "technological innovations, many of which were dramatically demonstrated in the Gulf War, are giving rise to what is being called a "military-technical revolution." This "revolution" would have a dramatic effect on the Army and land warfare through five dominant trends: lethality and dispersion; volume and precision of fire; integrative technology; mass and effects, and invisibility and detectability. [2] General Sullivan drew on these five trends two years later as the key domains in "Information Age" warfare as critical elements of the operational environment.[3]

The efforts of the mid 1990's focused on creation of Army battle labs and a series of experiments to be known as the Task Force XXI initiative. New technology systems were initiated to leverage the power of computers in the Army's field systems. The Army published its first digitization master plan in 1995. The intent of this plan was to focus priority of effort and funding on two main goals. The first goal was to expedite the information flow and accelerate the decision making process. The second goal was to create shared situational awareness that provided everyone with the same near-real-time picture of their relative battlespace.[4]

In 1988, Peter Drucker, a prominent American writer, teacher, and consultant who specialized in strategy and policy for businesses and social sector organizations, cautioned that advanced data processing was not necessary to create an information based organization. He also stated that at the close of the '80's, our ability to positively leverage information technology was still limited. Drucker stated that the "best workers have done with information technology is to "only do faster what they have always done before."[5] General Sullivan recognized the same limitation. He stated that the future would "find predictive modeling, integrative technology, precision guidance systems, and other high technology increasingly useful--necessary, but not sufficient."[6] While recognizing the digitization of the battlefield as a major advance in the conduct of warfare, he reinforce the art and science of battle command by cautioning that the limiting factor in the quest for making maximum use of integrative technology will not be the hardware; it would be human and organizational.[7]

Integrative technologies will enhance the ability of commanders and their units to fight with scarce assets. The complete use of integrative technologies will revolutionize command and staff procedures. Software will allow much of the information now transmitted by radio and synchronized on acetate and charts to be self-synchronized automatically, computer to computer. Smart command and control systems will create a common perception of the battlefield and the theater among members of a joint task force. This perception, in turn, will facilitate the rapid massing of combat assets—precise weapons systems and maneuver forces--to attain objectives decisively. Such a development will not eliminate the necessity for staffs and commanders, but the art and science of decision making and staff synchronization will change radically. [8]

A field of practice solidified through the 1990's that supported a holistic approach to increased organizational competency utilizing information technology aligned with business processes. This became known as "Knowledge Management." Joint and service specific doctrine has inculcated the power of technology in its policy and doctrine employing key aspects of Knowledge Management.

The software solution set to carry this vision to the field was the Army Battle Command System (ABCS).[9] ABCS, however, did not fulfill expectations when tested in combat in both Operation ENDURING FREEDOM AND Operation IRAQI FREEDOM and subsequent unit rotations. While the capability of individual systems would vary, the integrative systems of systems capability to provide relevant information to a commander that could lead to sound decisions through situational understanding proved insufficient.

ABCS as deployed today is an ineffective systems of systems capability to provide commander's situational understanding. Despite significant effort, the interoperability between ABCS software remains immature. The impact is that each system has strength but the integration of these strengths is not robust. A graphical common operational picture (COP) on one system will not look like a COP on another system. Significant human intervention and coordination is still required for units to "discover" the common relevant operational picture (CROP) of another unit. Finally the development of battle operating system (BOS) specific information systems has served to segregate the commander's staff as well. Users understand their own system but cannot possibly understand the systems of each other staff member. As a result, staff coordination is hindered as elements spend inordinate time discerning ground truth of their information systems rather than providing the commander critical information. Finally, COP presentations in current systems provide graphical output, updated as needed, showing live feeds, control measures, etc. Regardless of what is displayed, the COP still requires a staff to interpret it. The result is that ABCS will not allow the organization flexibility to grow and optimize for new operating environments.

The nature of our engagement in coercive Stability Operations also demands "a different COP." The COP today that generates understanding is not necessarily one graphical display composed only of visual entities to allow commanders to see and track forces from home station through arrival in theater to combat employment.[10] The core product of ABCS focuses on visual displays of information tailored to a BOS function. The implication is that focusing on visual information in hostile environments such as Iraq and Afghanistan places the burden of gaining situational understanding on the commander and his staff instead of making it easier for them. What is needed is a visual and non-visual information set of capabilities that will unify, expose, and conduct two way transport of information that, when shared between all echelons of command, leads to a more comprehensive situational understanding and supports decisions that align military action with the appropriate range of lethal/non-lethal effects. Non-visual information that can be compiled and sensibly organized is equally if not more relevant to a fight where the center of gravity may be legitimacy and lines of operations may be conceptual rather than physical.

To meet this emerging non-visual information management need and compensate for the inability of the Army to respond programmatically, deployed units have developed and deployed their own information systems or employed advanced research projects that are not within the ABCS requirements scope or funding authorization to support. The result is some very useful systems being employed that enhance unit effectiveness but at the same time, given lack of unity of effort, hinder unit to unit knowledge transfer and further fragment the Army's need to unify command and control information systems.

The intent of this SRP to review the effectiveness of command and control systems to support combat operations since U.S. forces intervened in Afghanistan in 2002 to its present day. An analysis of recent ABCS testing and operational evaluation and established plans for battle command migration is balanced with the momentum generated by unit initiatives . A review of current command and control develops is presented and recommendations are presented that leverage current Army efforts with future initiatives to align what can be a highly complementary suite of software development tools for the commander.

Digitization, Doctrine, and Battle Command Analysis

The Army's doctrinal approach to digitization and command and control systems begins with a sound foundation that states "a command and control system is the arrangement of personnel, information management, procedures, and equipment and facilities essential for the commander to conduct operations."[11] The compilation of these concepts presents a

comprehensive Knowledge Management approach. Army doctrine acknowledges increased complexity but expects a trade off of more timely and accurate relevant information.

Army doctrine also outlines the four key dimensions of the command and control environment to assist sense making of complex military operations. These dimensions are human, uncertainty, time, and land combat operations. There are expectations of information systems in each of these dimensions.

Emphasis within the human dimension adequately focuses the art of command and control by making clear that information systems do not have a capacity for judgment, intuition, and imagination. In short, information systems cannot apply cognition that leads to knowledge and understanding.[12]

In addressing the uncertainty dimension of operations, Army doctrine expects well-trained staffs within mature C2 systems to use information management to reduce uncertainty. The goal that doctrine presents is to provide commanders knowledge and hence understanding based on relevant information. Doctrine further presents a balance between the art of command and the science of information management.[13]
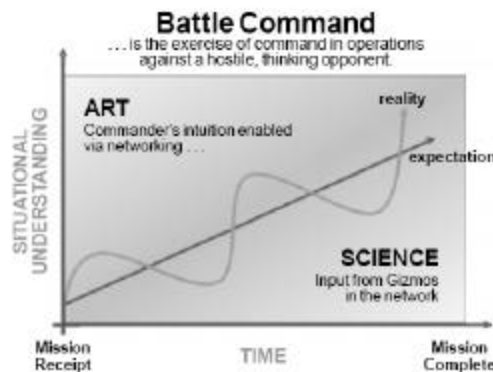

FIGURE 1. THE INTERACTION BETWEEN THE ART AND SCIENCE OF BATTLE COMMAND.[14]

As the U.S. Army's Combined Arms Center Commander, LTG William Wallace presented a visual concept (figure 3) to depict the relationship between the art and science of battle command. LTG Wallace asserted that commanders and staffs balance art and science within information management. Above all, decreased uncertainty depends not only on the quantity or quality of information but also on the analysis of it. Faulty information management may increase uncertainty. Information only reduces uncertainty if it contributes to knowledge or understanding. This concept was aptly presented ten years earlier by then Chief of Staff of the

Army General Gordon R. Sullivan when he reinforced that war demands both science and art from the leaders who wage it. To think that one without the other will solve the problems posed by war is to err and err seriously. [15]

Within the time dimension, doctrine expects effective C2 systems to allow friendly commanders and their forces to use time more effectively than the enemy. The goal is to achieve relative advantage in timeliness over them. Commanders who follow C2 practices that provide information to lower levels of command allow their subordinates to exercise initiative and make better decisions.[16] This dimension of land combat and the need to provide relevant information down to the "last tactical mile" is one area that Multi-National Corps – Iraq (MNC-I) focused on as a key need in Iraq.[17]

FM 6-0, *Mission Command: Command and Control of Army Forces*, maintains a land combat expectation that information technologies have the potential to empower subordinates and thus to increase the tempo of operations beyond the level at which adversaries can hope to respond. Modern information systems such as the ABCS are expected to substantially enable mission command. Above all, information systems are to allow commanders to provide a COP to subordinates to guide the exercise of subordinates' initiative. The commander's C2 system therefore manages information to produce and disseminate a COP to the commander, staff, and subordinate forces. The C2 system is to support the commander in directing forces by transmitting execution information.[18]

Net Centric and Army Knowledge Management

In May 2003, the Department of Defense (DOD) Chief Information Officer (CIO) published a Net Centric data strategy and described this strategy as a "key enabler of the Department's Transformation by establishing the foundation for managing…data in a net-centric environment." The key attributes presented in the strategy included:

- Ensuring data are visible, available, and usable when needed and where needed to accelerate decision making.

- "Tagging" of all data (intelligence, non-intelligence, raw, and processed) with metadata to enable discovery of data by users.

- Posting of all data to shared spaces to provide access to all users except when limited by security, policy or regulations.

- Advancing the Department from defining interoperability through point-to-point interfaces to enabling the "many-to-many" exchanges typical of a net-centric data environment.

The strategy also introduced the concept of "Communities of Interest" to describe a collaborative group formed to exchange information and establish standards in pursuit of shared goals.[19] This was significant as this guidance and supplemental policy became the foundation to future software development. During this same time, the Army Chief Information Officer continued to leverage DOD Net Centric Transformation guidance to organize policy, the Army information management organization, and information technology goals in an evolutionary manner.[20]

The Army CIO was able to gain and communicate a plan through the evolution of the Army Digitization Master Plan as it evolved to an Army Knowledge Management Plan.   The first part of this plan identifies "Critical Enablers" that are fundamental enterprise level changes which will enable the Army to provide information management services to a knowledge-based, network-centric force in the contemporary and future Objective Force environment.. The second part is organized around the five Goals of the Army Knowledge Management (AKM) strategy and contains many separate, but integrated initiatives, which implement the Army's five AKM goals.[21] The Army Knowledge Management goals are:[22]

> • GOAL 1: Adopt governance and cultural changes to become a knowledge-based organization.
>
> • GOAL 2: Integrate Knowledge Management concepts and best practices to promote the knowledge-based force.
>
> • GOAL 3: Manage the infostructure as an enterprise to enhance capabilities and efficiencies.
>
> • GOAL 4: Institutionalize Army Knowledge Online (AKO) as the enterprise portal to provide universal secure access for the entire Army.
>
> • GOAL 5: Harness human capital for the Knowledge-based organization.

The Army CIO is linking DOD net-centric goals with Army goals and implementing a plans and procedures to advance the Army information technology infrastructure. The Army Battle Command suite of software systems have a requirement to align with net-centric enablers as AKM goals. The priority is to do this within a joint and Army doctrinal foundation for Battle Command.

Knowledge Management Basics

Knowledge Management is a deliberate, systematic business optimization strategy that selects, distills stores, organizes, packages, and communicates information essential to the business of a company in a manner that improves employee performance and corporate

competitiveness.[23] The "holy grail" of Knowledge Management is the ability to selectively capture, archive, and access the best practices of work related knowledge and decision making from employees and managers for both individual and group behaviors.[24] The desired business output is to increase productivity, enhance innovation and creative output in order to outdistance competitors.[25]

The primary topics addressed in Knowledge Management are the organization, its workers, processes, and technology. The theme of organizational change is corporate culture change, gaining knowledge from customers, using knowledge to create revenue, and capturing individual knowledge for organizational consumption. The knowledge worker domain includes traditional human behavioral issues such as overcoming resistance to change, offering incentives and rewarding workers for embracing behavioral change that could appear to be a threat to continued employment.

The process aspect of Knowledge Management addresses business process engineering and seeking innovative methods to leverage the information management life cycle to increase organizational competency and competitiveness. Since the advance of technology catalyzed the Knowledge Management initiative, it is not surprising that exploring computers and communications technology consumes the bulk of Knowledge Management focus. The technology of Knowledge Management can consume significant resources and bring no reward if not carefully planned and executed.

A High Level Knowledge Management Primer

From an information technology standpoint as well as the standpoint of the art and science of command and control, it is important to understand the cognitive hierarchy and how bits of information become usable. The first point is that we retain knowledge inside ourselves. This is data that we have processed as information, applied a cognitive process to in order to generate knowledge and then transformed into judgment to achieve understanding.

Knowledge that remains within us is tacit, known only to ourselves. Knowledge that we are able to formalize and communicate for external use is explicit knowledge. This concept is important for two reasons. First, effective Knowledge Management is knowledge sharing. The tacit must become explicit. Secondly, technology cannot substitute for human cognition.

Technology will take inputs, produce information based on rule sets established, and will produce output. Theoretically, the better the rule sets, the better the information output. Technology has limited capability to add meaning to information and produce knowledge. Humans must add cognition to achieve knowledge to produce usable, actionable understanding.

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The challenge at all levels is to then make this knowledge visible to the organization and reusable. To remain competitive in business as well as today's current battlefield, this knowledge must be actively managed to remain relevant to the environment. For the sake of focusing on the doctrinal and practice aspects of current initiatives, foundation terms and concepts are relegated to endnotes.[26] There also is a life cycle that is important to understand how data is created, managed, and retired. This cycle is also relegated to a footnote.[27] A concise method of understanding these components is depicted in Figure 1.
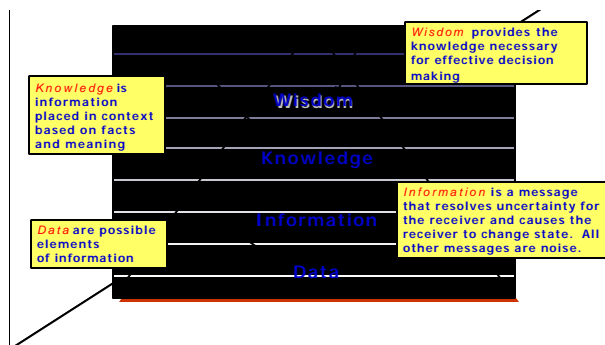

Wisdom provides the knowledge necessary for effective decision making

Knowledge is information placed in context based on facts and meaning

Information is a message that resolves uncertainty for the receiver and causes the receiver to change state. All other messages are noise.

Data are possible elements of information

Wisdom

Knowledge

Information

Data

FIGURE 2. COMPONENTS OF KNOWLEDGE[28]

Doctrinal Framework for Command And Control

Joint Pub 6-0 also presents a visual representation of this hierarchy shown in Figure 2. The key point in this hierarchy is that as data is manipulated and becomes usable, the value added process becomes more individually cognitive. The difficult aspect of Knowledge Management is to transfer knowledge to explicit forms. Knowledge that resides in us such as our beliefs, perspectives, and values can be extremely difficult to transfer.[29]
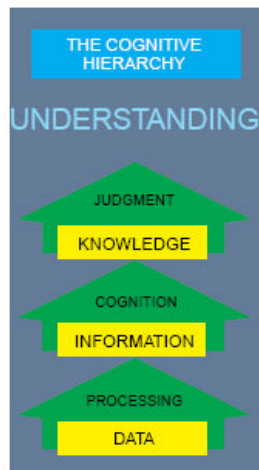
FIGURE 3. THE COGNITIVE HIERARCHY. [30]

    "Better situational understanding allows commanders to focus their intuition on fewer unknowns and better visualize the current and future end state."[31] From a supporting information technology perspective, software capability is more robust at the bottom of the chart but transitions to the need for human intellect as one advances up the cognitive hierarchy. The importance of this is that in today's contemporary operating environment (COE), a dynamic, highly adaptive, and complex enemy stresses staff and leader ability to maintain decision superiority. The traditional software systems designed for dominant maneuver do not allow commanders to gain situational understanding in an insurgency where the center of gravity is not geographic or force based but rather idea or legitimacy based. In reviewing his organic ability to command and control forces of the 1st Cavalry Division, MG Peter Chiarelli states that "Even our own C2 systems…had to be turned upside down to focus on providing the tip of the spear with the in formation and actionable knowledge needed to determine the best course of action."[32]

The Role of ABCS In Afghanistan

    In the summer of 2002, the 82d Airborne Division deployed to Afghanistan, relieved the 10th Mountain Division and stood up Coalition Task Force – 82 (CTF82). Commanded by then MG John Vines, the task force soon realized that their command and control systems were inadequate for the operating environment. CTF82 described the environment and operational shortfall as follows:

> Coalition Task Force 82 (CTF82) is engaged in combat operations in a battle
> space characterized by complex terrain, and extreme distances, where any

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single operation routinely includes U.S. conventional and special operating forces, other U.S. Government agencies, Afghan National Army and non-governmental agencies.[33]

MG Vines also asserted that Afghanistan was completely unlike any previous threat and that this threat could not be templated as current doctrine prescribes. He clearly stated that "intelligence drives operations," "time sensitivity is critical" and our forces must be able to rapidly collect assimilate and act on this data in unique ways if we are to have any effect.[34]

MG Vines further asserted that Army units in country had been partially fielded stove-piped software systems that do not support the integrated way the task force needed to fight. MG Vines stated that the ABCS capability that the Division had been provided had been "dumped on them and didn't integrate." As a result, the unit had built much of its own useful capability on its own, outside the acquisition process. The 82D Airborne Division had created a web based product on SIPRNET that provided all commands with relevant data of the force. All staff support aspects are tracked, charts that feed a battle update brief, and an hourly snapshot of the blue picture derived from an MCS-L in country.[35] MG Vines wrote a memorandum to this affect asking for support to prototype software development in theater. The Department of the Army G3 response was to applaud CTF82 effort and inform the commander that the G3 was standing up a Battle Command Division within the G3 to serve as the focal point within the Army for the digital integration, synchronization, and standardization of Battle Command efforts.[36]

The focus had shifted to the coming ground war in Iraq. Some product managers deployed engineers to the Afghanistan area of operations and, depending on their funding and command interest, supported changes to systems in theater that were then incorporated into software builds of the main product. This effort, with the purpose to enhance the operational effectiveness of the task force, was largely ad hoc and disconnected from the formal requirements determination process.

Operations in Afghanistan and commander feedback led to a conclusion that ABCS, as a system of systems, had minimal operational value to the warfighter. Certain systems excelled at specific tasks, but no collective benefit was achieved. The key dimensions of command and control previously mentioned demanded a different mindset that ABCS could not accommodate. The commander needed different information to develop understanding, and reduce uncertainty. To fill this void – enhance the science aspect of command - CTF82 (and soon every Division that deployed to either Afghanistan or Iraq) developed their own web based capability better suited to the commander's needs.

Afghanistan demonstrated to the Army that its product development method and doctrinal approach to digitization was not aligned with the COE. Contrary to FM 6-0, BOS information

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systems managing BOS specific relevant information to improve the quality of information given to commanders is a faulty concept. In reality, BOS information systems development optimized its capability to provide relevant information to the BOS specific staff. The ability to share this information with other systems and mainly the primary command and control systems did not exist.[37] The collective entity of ABCS in Afghanistan succeeded then in providing a basic COP, but did not significantly enhance the environment of command and control (human dimension, uncertainty, time, land combat operations). What Afghanistan and its environment foretold was the knowledge management tasks that would be required in Iraq after major combat operations.

Standard battle command systems also did not support the enablers for DOD's Net-Centric transformation.   ABCS software could not ensure data are visible, available, and usable when and where needed to accelerate decision making. There was no tagging of data with metadata to enable discovery of data by users. Some systems could post data to shared spaces, such as files to a web server, but in general, unit developed, web based systems achieved greater net-centricity than ABCS. Most data that could be exposed and shared by other systems were done so through point to point effort, accounting for unique data interpretations and graphical rendering needs of each systems.

Iraq: ABCS Performance Assessment

Operation Iraqi Freedom I (OIF I) continued to test the Army's digitization efforts. In preparing for the invasion of Iraq during the fall of 2002, the Army accelerated the fielding and training of ABCS capability to major combat units scheduled to deploy in support of OIF. V Corps task organized units, such as the 3d Infantry Division and 101 st Airborne (Air Assault) Division, where equipped and trained with ABCS, but the V Corps timeline did not support training new systems for the Corps commander and staff. As a result, the Combined Land Forces Component Command and V Corps fought this phase of the conflict with one set of C2 systems and the subordinate tactical units either fought with different systems or adapted to the V Corps architecture once in country. Most units chose this option while others accepted additional burden at the Division staff of translating graphical formats between their higher and subordinate units.[38]

The combined arms maneuver warfare environment of OIF I played on the traditional strengths of the U.S. Army. The officer and enlisted professional education system as well as the Army's combat training centers reinforced excellence in this type of warfare. The result was the leaders generated knowledge in traditional forms of information and accepted the uncertainty as is correlated to uncertainty encountered in training. The Combined Arms Center

concluded that there were three major variables in controlling a combat engagement: "Where are my troops?" "Where is the enemy?" and "Where are we in relation to each other?"

A review of OIF I combat operations concluded that Blue Force Tracking[39] (BFT) enabled commanders to understand troop location. High-resolution maps on screens that showed their units helped them understand location relative to each other. Few felt they had the fidelity of enemy disposition desired, but nonetheless concluded that commanders had sufficient grasp to fight with confidence.[40] Other systems also performed their BOS function well, most notably AFATDS and AMDWS. Many other systems that performed well were not part of the ABCS effort, but rather originated from other services or were commercial technology that showed enough promise before the ground war to become an information system in the appropriate staff and command element.[41] The Army concluded that the investment had shown promise and that the digital network allowed units to see themselves and their activities. The result was situational understanding. "Confident that they knew the location of their units, commanders could decide rapidly where, when, and how they would be employed."[42]

A significant shortfall of ABCS in OIF I was that, as a system of systems, it did not, adequately support the four dimensions of command and control. Some systems fell short, providing relevant information to their stovepiped BOS while the systems of systems failed to interoperate in the manner expected to provide the commander relevant information. As a result, commanders fought the strength of BFT and other ad hoc systems that satisfied the three requirements mentioned before. Answering these questions after OIF I, however, was not sufficient for mission success.

As with ABCS experience in Afghanistan, current battle command capability was not on track to support the critical net-centric enablers. These was expected as DOD did not publish policy, nor were proper enabling system fixes on hand before May 2003, well after primary ground operations ceased. ABCS in Afghanistan and Iraq differed more by availability, method of employment, and commander preference than by significant change in software version.[43]

A Significant Change in the Nature Of Battle Command

During the development of ABCS "Good Enough" and the planning stages for a combined joint tactical COP workstation, the Iraqi environment rapidly became similar to that of Afghanistan. As III Corps assumed the Multi-National Corps – Iraq (MNC-I) mission from V Corps, units began to transform themselves both organizationally and technically to prevail against an increasingly aggressive and adaptive enemy. Enemy tactics, techniques, and procedures were updated continuously and U.S. forces adapted as well – they remained

competitive. MG Peter Chiarelli, commander of the Army's 1st Cavalry Division during it's OIF II rotation (approximately February 2004 through March 2005) stated that to prevail in today's contemporary operating environment, critical thinking, professionally grounded in the controlled application of violence, yet exposed to a broad array of expertise not normally considered as a part of traditional military functions, will help create the capacity to rapidly shift cognitively to a new environment. We must create an organization built for change, beginning with the education of our officer corps.[44]

This is dramatically different than the OIF I measure of success of accepting knowledge of location and activity and generating situational understanding. New tools would be needed to help the Army and Joint forces address a nontraditional enemy. Traditional systems provided graphical displays that enabled well trained commander's and staff to generate understanding. Because the enemy was not a set piece force acting in the traditional sense of maneuver, these same displays now did not provide information to enable individual or organizational understanding.

During the 2004 timeframe, III Corps (now MNC-I) recognized that their traditional information management tools were inadequate. In preparing to replace III Corps, XVIII Airborne Corps, commanded by former CTF82 Commander, LTG John Vines also knew that traditional battle command tools and the notion of a COP were not the same as envisioned under the previous "dominant maneuver" construct.

XVIII Corps recognized an evolutionary trend in OIF rotations. The premise was that with each rotation, a higher standard of knowledge would be required to achieve success. In OIF I, a common map generated sufficient situational understanding. In OIF II, BOS's were able to generate enhanced Knowledge management. The goal for OIF III would be to utilize Net Centric concepts to increase cross – BOS Knowledge management. The end state of data management would not just be a display but the ability for users to manipulate the data and perform analysis.
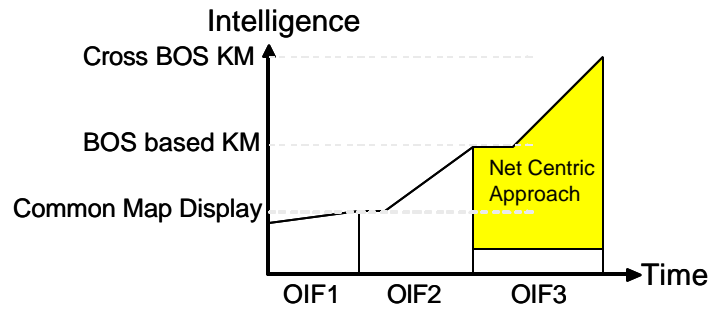
FIGURE 4. XVIII AIRBORNE CORPS KNOWLEDGE MODEL. [45]

The problem with this model from a development perspective was that traditional ABCS development would not achieve the results required. ABCS developers still struggle with basic COP interoperability. Organizational barriers, significant differences in technical approach (data, map engines, software language, etc) development processes, and funding make it extremely difficult to synchronize efficient delivery of eleven battle command systems. While the bulk of Army effort remained in unique software development, the current environment lent itself to placing significant emphasis on commercial products that are optimized for competitive business processes.
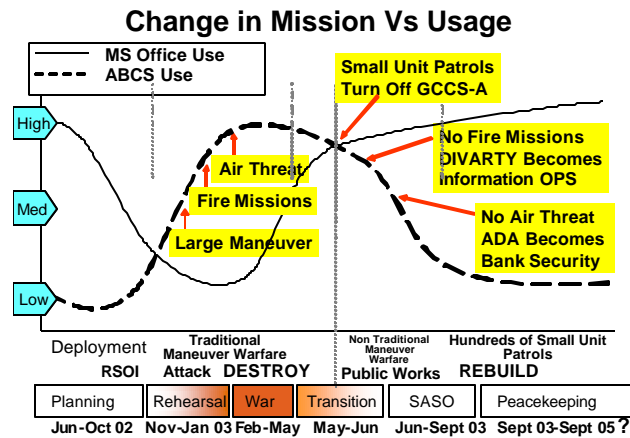

FIGURE 5. SHIFT IN OPERATIONAL USE OF INFORMATION SYSTEMS. [46]

Microsoft Office (MS Office) use generically refers to commercial products (primarily Microsoft based) that support mission accomplishment. The concept presented, and being verified in Iraq today, is that as traditional offensive and defensive maneuver warfare transitions

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to stability operations, greater emphasis is placed on commercial products and tools. The need for integrated ABCS capability declines.

As a result of this shift in emphasis, traditional Army software development could not support the requirements this generated. Even before the development issue, TRADOC and the Department of the Army had to resolve many similar efforts and existing requirements development. As a result, units have launched their own developmental efforts.

ABCS System Of Systems Evaluation

Much is expected of current Army Battle Command Systems. Doctrinally, the expectation is that well-trained staffs with solid procedures can use information systems to facilitate understanding of the commander's intent. Doctrine focuses on information systems providing graphic displays as the means to obtain feedback from subordinates. The intent of graphics plus two way feedback leads to a shared situational understanding among all participants.[47]

In March through April 2005, the U.S. Army's Fourth Infantry Division (4ID), in preparation for deployment, supported a system of systems test within their mission readiness training cycle. Eleven systems were under test at the time.[48]   This event was focused on individual system capability, but also maintained as a greater priority, an evaluation of the operational effectiveness and suitability of the system of systems (SoS). The goal of a system of systems evaluation was to test and evaluate how these BOS specific software systems could share information and provide a collective capability.

The Army's summary finding was that ABCS SoS was not operationally effective, not operationally suitable, and not survivable to fulfill the Commander's 7+1 Mission Needs defined by the Army Chief of Staff. The primary reasons supporting this evaluation were:

- Inflexible networking products complicating and often preventing the ABCS architecture from matching the unit architecture.

- The training program did not prepare the unit to employ the ABCS as an integrated and comprehensive command and control system.

- Unacceptable times to process overlays and database updates, incompatible graphics types and formats, and the unreliability of the ABCS Information Services server.[49]

The operational evaluation concluded that ABCS could not fulfill its doctrinal intent. What the Army had in fact found out was that its many complicated systems had produced a human intensive system that did not significantly help soldiers accomplish missions effectively. The major impact of this conclusion was a directive signed by the Army's CIO directing a three phased plan to correct these deficiencies. Known as the "500 day" plan, it became the main

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focus for Army CIO and subordinate materiel developers. The goal of the 500 day plan is to support greater battle command capability in the near term, institutionalize battle command capability and reassessment in the mid term, and focus on joint interoperability to include waveform, network, and platform integration challenges in the long term. The objective of the process is to ensure warfighting capabilities are embedded in the modular force and embedded within the joint architecture.[50]

New Mechanisms for Visualization

One of the key observations from OIF was that a few simple systems could enhance combat power and catalyze leader initiative more than many, very detailed systems.

> Coupled with BFT, commanders using C2PC, ABCS, and one or two other aids--including the Automated Deep Operational Coordination System--could see their forces, plan and execute fires digitally, track the air space, and achieve high-resolution situational awareness of "blue" activities.[51]

At the same time, deployed forces were telling the Army that they needed different automated tools that what ABCS offered.

III Corps, serving as Multi-National Corps – Iraq (MNC-I) also asserted that ABCS did not support the information requirements of the Corps Commander resulting in a "capabilities gap." Contrary to organizational and operational design intent, the Corps supported a much larger and diverse population base to include Joint, Coalition Partners and Other Government Agencies. Systems had to operate on both Secret Internet Protocol Router Network (SIPRNet) and Central Command's Combined Enterprise Regional Information Exchange (CENTRIX) system. III Corps reinforced that ABCS was not designed to support the information requirements of the battle space nor was it flexible enough to meet an ever changing environment with fluid task organization.[52]

To respond to this gap, MNC-I C3 Information Management Division developed the Collaborative Information Data Network Exchange (CIDNE). The intent of CIDNE was to incorporate all disparate databases in theater, be web based and platform independent, and integrate with the Corps' primary C2 system (C2PC) or built in… map viewer.[53]

To address the command and control needs and capability gaps they foresaw, the XVIII Airborne Corps called a meeting at Fort Bragg to communicate their vision of the operating environment and the technology needed to prevail against the enemy. The Corps sought support for a capability to provide web access for key operational data across functional areas. The purpose of this effort, termed "FusionNet," was to allow the Corps to:

Enable the art of command as well as the science of control by using cognition to achieve knowledge and judgment to achieve understanding, thereby enabling decision makers at all echelons to give accurate and timely guidance within the context of the current situation on the ground.[54]

Functionally, FusionNet is a suite of applications designed to meet the need for timely, accurate and relevant information from the company through corps echelons, across all Battlefield Operating Systems (BOS) and functional areas, in garrison and in the field. The intent of FusionNet is to complement existing Army and Joint battle command and enterprise information systems, bringing information from the enterprise to the desktop of commanders and staff in operational units and making ground-truth information from the lowest-connected echelon available to the enterprise. One key aspect of FusionNet is the recognition of the presence of critical data across the battlespace in disconnected databases. The Corps implemented Fusion Net to the tactical level to create a common data entry and management method for critical operational data.

As an example of desired functional end state, FusionNet will take combat patrol reports (SIGACTS) and provide operational fusion capability that will interoperate with the Joint Intelligence Operational Capability – Iraq (JIOC-I), which provides Intelligence fusion, to provide the commander with the ability to share real time data, horizontally and vertically. [55]

FusionNet was not the first initiative outside of ABCS to address the Army's failure to provide a standardized Battle Command Knowledge Management tool to meet operational requirements. What XVIII Airborne Corps did that previous commanders did not was seek formal Army approval of an Operational Need Statement (ONS). Maneuver Control System had made significant strides in web integration of the COP, but the requirements demanded in the FusionNet concept did not have basis in any ABCS Operational Requirements Document. Materiel developers assisting MNC-I prior to ONS approval and funding were doing so at risk of reprimand and removal of funding.[56]

Regardless of requirement justification, MNC-I pursued the FusionNet initiative, seeking to tie situational reporting tightly with the JIOC-I. In a memorandum by the Multi-National Force – Iraq Information Management Officer, the integrative capability of FusionNet and JIOC-I was showing operational benefit.

The JIOC-I and FusionNet will assist in solving some of the critical Intelligence Operations information management shortfalls in Iraq. FusionNet is the operational reporting capability and JIOC-I is the Intelligence analytical capability. These combined capabilities will enable Soldiers to rapidly exchange intelligence and operational data, and visualize the data in geospatial context. [57]

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This was primarily communicated by XVIII Airborne Corps in an ONS initiated in 10 November 2004.[58] A formal ONS was submitted 25 June 2005. Nearly one year later and three months prior to XVIII Airborne Corps transfer of authority with V Corps, the Department of the Army approved the ONS and recognize the Corps' initiative as the way ahead for information and knowledge management as well as the "way ahead for an Army Enterprise solution for a standard Knowledge Management/collaboration capability." [59] ." HQDA further directed the CIO/G6 to initiate a process to "select, integrate, and package for the tactical environment a standardized Army Best of Breed KM/collaboration solution."[60]

Another significant system that had a tremendous impact at the Division and below level was Command Post of the Future (CPOF). During predeployment readiness exercises, the First Cavalry Division Commander received a US Defense Advanced Research Project Agency briefing and demonstration on the system and then utilized the system in a November-December 2003 Warfighter exercise. MG Chiarelli, the Division commander was sufficiently impressed and received Army approval to deploy the system during the Division's Iraqi rotation.[61]

While in Iraq, all primary staff officers had the CPOF system. MG Chiarelli stated that the system for the first time allowed him to unify his intelligence and operations on common capability. He reinforced the significant power of the system to get into the minds of his commanders. "I don't want to see them on a VTC, I want to know what is in their minds."[62] What CPOF provided was a mechanism to expose each units COP to each other without significant human intervention. The graphics allowed information to be displayed on the system that provided the reviewer context and meaning to the information. The primary limitations of CPOF employment was a unique network architecture that no other unit could replicate as well as the inability to share graphics and information with ABCS systems. So, while it advanced significantly the science of command and control, the system did present difficulties for subordinate staffs who had to manually input data from all other systems. Even so, the suite of ABCS systems, as fielded to the 1st Cavalry – one of the oldest versions – had little to offer.

Limitations continue to be mitigated and the Army supports these systems in the Iraq area of responsibility. This is significant because the fact that a non-production approved system is in country managing daily combat operations is unheard of in Army acquisition. This method reinforces reminds us that when commanders see benefit, they should be willing to accept risk. As part of the FusionNet ONS, XVIII Airborne Corps recommended that an in country test group be established.[63]

<u>Web Based Capability Development</u>

The Army CIO has directed that to support A Knowledge Management goal four, the Army will Institutionalize Army Knowledge Online (AKO) as the enterprise portal to provide universal secure access for the entire Army. As mentioned with CTF82 in Afghanistan, units developed web based capability to perform a host of tasks. The 1 [st] Cavalry in Iraq initiated the "CAV Knowledge Network." Users could post questions or tactics, techniques, and procedures (TTP's) for other user's to implement. AKO has broadened the implementation of this within its "Knowledge Networks" section. One of the primary sections is the Battle Command Knowledge System (BCKS). This section ties many user groups together in communities of interest with the purpose of functional knowledge.

Colonel Robert Brown, Commander of 1st Brigade, 25th Infantry Division (Stryker Brigade Combat Team), stated that one key aspect he lauds is the BCKS. He states that Army doctrine writers were unable to develop and sustain effective doctrine for their Stryker Brigade deployment. A solution to this was the BCKS. He suggests that knowledge sharing web sites such as this represent doctrine for the future. He further states that branch schools and the Center for Army Lessons Learned should have internet connections with units in the field to share tactics, techniques, and procedures. This in turn would enable units to train, prepare and fight effectively. [64]

Because BCKS requires users to have full AKO access, it is not suitable for a Joint, Interagency, Intergovernmental, Multinational (JIIM) environment. Potentially users could be sponsored by full members and gain access. A second issue is that the community of practice leaders and subject matter experts will be located at the Combined Arms Center at Fort Leavenworth. XVIII Airborne Corps recommended that these leaders have an in-theatre presence to provide a higher level of situational context and increase their credibility with troops on the ground. [65]

BCKS also serves only as a general knowledge base at this time. Users must pull specific input. Users must also actively create and update this knowledge base continuously. In an environment of competing applications, unit staffs will focus on their own systems as these have the greatest reach in their own particular unit. Entering data multiple times in similar yet different systems becomes frustrating and produces little value added for those burdened by this task.

BCKS does present a means to unify basic lessons learned, moderated by a qualified leader, in a single area. While it represents a single Army effort to close a capability gap, units

will most likely not eliminate their internal web based systems until the BCKS can prove it is meeting their needs and unifies this mission space across unit and service boundaries.

Iraq Lessons Learned Redirect ABCS and Joint Development

Recognizing the significant benefit of the digital command and control technology, the Army desired to field a basic capability to the whole Army. At the same time, Army leadership recognized a significant interoperability deficiency. As a result, the Chief of Staff of the Army crafted an information technology investment strategy that became known and "Good Enough." The Good Enough concept focused on what was the "7+1" commanders needs and development that was good enough to achieve minimum operational effectiveness and then field these information systems Army-wide.[66] The objective of this strategy was to proliferate BFT across the Army and stop further battle command software development. Money reaped from averted further development was used to help field battle command systems to the total Army down to Brigade.[67]

As a result, the Training and Doctrine Command (TRADOC) tasked the Good Enough management mission to the Combined Arms Center (CAC). CAC assigned the mission to the newly reorganized TRADOC System Manager – Battle Command (TSM-BC). TSM-BC previously was TSM-Maneuver Control System (MCS) and Global Command and Control System – Army (GCCS-A). TSM-BC now had the management control and CAC Commander delegated authority to define the "limit of advance" for ABCS. The product of this output would be termed ABCS "6.4" and would be fielded and tested with the 4th Infantry Division as they prepared for their OIF deployment in the fall of 2005.

Battle command materiel developers continued to train and deploy follow-on units while also preparing to develop a final capability of battle command software. No new missions were assumed based on lessons learned in Afghanistan or Iraq that were not openly vetted with the Combined Arms Center.

Within the commander's needs, priority of development effort was to focus on increasing the interoperability of the battle command systems. Program Executive Office, Command, Control, Communications – Tactical (PEO C3T) leveraged the key enablers of the DOD Net Centric data strategy and directed the development of a method whereby each system could expose, or "publish" its data to others to a central location in a common format. Once exposed in a central location, other systems could then "subscribe" to this content and receive the needed graphics. This concept of publishing and subscribing (PASS) would ensure that data are visible, available and usable. Data was posted to a shared space to provide all users

access, and this concept began the implementation of "many to many" exchanges rather than having each software developer account for the unique data handling needs of each other developer.

As of the fall of 2003, the Army software development mission focused on developing a Good Enough solution for developmental test by April 2004 and start of 4ID training by 1 September 2004. A system of systems operational test was scheduled and conducted in March – April of 2005.

One positive note from this effort is that that the Army and Marine Corps established two distinct initiatives to unify software development at the tactical level. The Army took the lead to develop a joint BFT solution while the Marine Corps was assigned the lead for continuing development at brigade and above.[68]

The Joint Staff, frustrated by a lack of common command and control capability that OIF I demonstrated, published a memorandum directing the services to combine tactical command and control capability. The implementing concept the Army and Marine Corps agreed to was for the Army to lead development of a "Brigade and Below" capability while the Marine Corps would lead a "Brigade and Above." The foundation products each service used to implement this were FBCB2 from the Army and C2PC from the Marine Corps.[69] Initial organizational turbulence, lack of funding, and Army priority of effort to developing, testing, and fielding a Good Enough solution delayed real momentum towards converging systems.

The Army Battle Command Migration Plan

The second major effort initiated by TRADOC was a Battle Command Migration Plan. The intent of the migration plan is to support Army Campaign Plan lines of operation 16 and 17, which are Battle Command and Network Architecture Integration. Given the Army had directed ABCS development to stop at version 6.4 combined with a Future Combat System (FCS) software development plan that would incrementally spin out over the next ten years, a large gap was created where software would need to be upgraded and sustained. To answer this need for a long term battle command software management plan, TRADOC constructed the Battle Command Migration Plan. The Battle Command Migration Plan is described as capabilities driven approach shaped over time. The goal of this plan is the consolidation of software systems to a materiel design that could support joint command and control and link to the Future Combat System.

The core of the Migration Plan is the structure of capability blocks. Each block bundles capabilities at a given point in time. Each block has a central theme based on expected system

maturity and priority of effort. The Army is to establish a standard cycle for development, testing, and fielding for each block capability. A central TRADOC goal is the effective transition from one block to the next. Similarly, backward compatibility will be of significant importance. Successful implementation over an extended period of time provides an understanding of how capability is combined, when systems should retire, and when new systems or applications are added.

> The intent of each block is to focus the materiel development effort on critical technologies designed to achieve the Capability enhancements between each Block. In doing so, it provides a steady growth of capabilities, allows for the consolidation and convergence of joint capabilities, the standardization of common services and architectures, with the overall end result of achieving a network of interoperable computers based on operational and BCT/Division joint standards.[70]
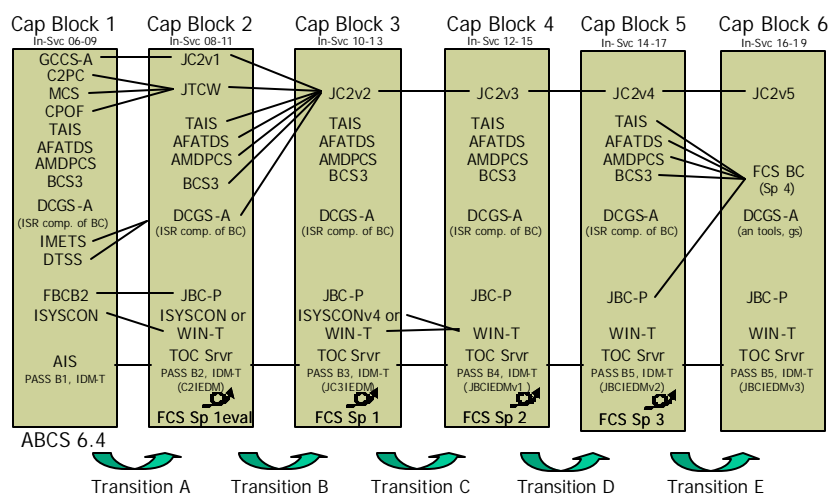

FIGURE 6. BATTLE COMMAND PROGRAM MIGRATION CONCEPT.[71]

The sum of these efforts over time will have a positive effect on Army and Joint Battle Command. Army battle command meetings have Marine Corps presence and the joint directed "Joint Tactical COP Workstation (JTCW)" and Joint Battle Command – Platform (JBC-P) are central aspects of battle command migration.

A significant limitation of this blocking process may be that key systems upgrade too slowly for the needs of the field. It also may hinder organizational change in the Army. Process and system rigor must be balanced with the nature of today's enemy. The migration plan does anticipate web enabled Net-Centric Enterprise Services (NCES) and the capability for remote

services and updates. Potentially this capability would enable a faster cycling of emerging technologies outside to the blocking process.

The migration plan accommodates FCS delivery of incremental capability as well (spin outs). Interoperability of software capability brought with a spin out will have a potentially adverse affect of unit command and control by segregating functions for periods of time between current force and future force software capability. The evolution of PASS to define and facilitate exposure of broader amounts of data will mitigate this risk, but current force systems will have to devote time and effort to render new data and information.

Towards Joint Command and Control (JC2)

The compression of programs as depicted in figure 4 is not insignificant. Success requires the elimination of long standing programs and unprecedented teaming of the joint community. As described previously, the Army and Marine Corps priority is the alignment of tactical command and control capability. This is represented in the transition in block 2 to a JTCW for command and staff functions as well as migration to a JBC-P. The successful migration of these programs in a joint context demands organizational and program control changes that do not exists today. An Assistant Secretary of Defense (Network, Information, and Infrastructure) approval of JC2 capability into Milestone A (Technology Development) represented a major milestone for interservice organization alignment for long term joint capability development.[72] This decision approved a draft joint organizational structure to manage mission capability packages aligned under JC2 as well as defined the requirements determination procedures, the net result being a greater role for Joint Forces Command. This action presents the clearest opportunity yet to create and manage long term joint command and control materiel development.

Implication for the Army's Future Combat System

While the Joint Services have defined and are embarking on a combined command and control development plan, the Army continues to develop FCS networked battle command. Interoperability will be aligned along "logical" lines rather than application integration.[73] While the result of FCS software development is intended to be superior battle command software, the danger to the Army is that it is not an effective joint capability. The result will be users in the same battlespace sharing information but not using the same capability to manipulate the information. The ability to share and effectively utilize data offered will then be driven by multiple program offices and contractors tasked to different priorities. The systems may develop different technical foundations that could fundamentally prevent data transfer.

All these issues have the potential to bring Army software development and the commanders that will rely on it back to a time where software systems were developed in a segregated manner that resulted in a packaged (system of systems) capability that could not effectively share data in the field and when data could be shared, may be rendered and manipulated differently by different systems intending to actually perform the same task. The end risk is that system uncertainty will add friction as ABCS has done in the past and commanders will have to continue to balance what they know and don't know about the enemy with what they trust or don't trust about their battle command systems.

Conclusion

When General Sullivan oriented the Army on the path of digitization in pursuit of a possible revolution in military affairs, the systems that the Army had been developing and those initiated such as FBCB2, put the Army on the right path to leverage the power of digitization. Joint and Army battle command doctrine accurately characterized the cognitive hierarchy and the needs of information systems to support individual and organizational situational understanding. Army doctrine and leaders also recognized that superior information will not eliminate operational friction. The commander must recognize the capabilities and limitations of his information systems and understand how this capability supports the human dimension in that these systems cannot apply cognition that leads to knowledge and understanding. Similarly, with uncertainty, time and land combat operations, battle command information supports the ability of the commander to mediate the art and science of command. Successful battle command support systems increase the commander's knowledge and understanding by providing timely, accurate , filtered, and relevant information.

ABCS as a system of systems by and large did not deliver this need for the commander. The Army's doctrinal expectation that BOS specific systems would support the staff was reasonable but effective integration of the ABCS capability did not materialize. In OIF I, commanders and staff compensated through familiarity of the original mission and a career orientation towards education and experience in maneuver warfare. As a result, a commander could rely on intuition and act confidently on imprecise information.

While great strides are being made by some ABCS systems, General Schoomaker was correct to cut further development with "Good Enough." Even developing towards the Good Enough end state delayed joint initiatives for over a year. The inclusion of a PASS capability is a great added benefit but systems still need to expend resources to accurately render what is being posted to this shared space. PASS does present an opportunity for developmental

systems like CPOF, FusionNet, and FCS to target one standard rather than negotiating "many to many" agreements with each materiel developer it desires information from.

Future success requires a true elimination of redundant capability in common mission areas and an ability to rapidly cycle field needs. Army battle command migration is a positive development to give the Army a forcing function to consolidate systems and define the service life of current force capability. Web enabled net centric concepts must be front loaded in the blocking concept and aligned with the information technology initiatives of units as approved by the Army CIO. If the enemy adjusts every three days, our support systems cannot adjust every four years, there must be an insertion mechanism or evolutionary development branch for certain promising initiatives.

Army and Joint battle command development should be a partnership with units in contested theaters. Development priority and cycling of solutions should take these users into account foremost. A new Joint Capability Integration Development System that provides Combatant Commands the ability to input in the requirements system my help resolve the gulf between a concept based requirements system and the immediate needs of the field. An in-theater battle lab presence tied to contractor and government software development and test sites will allow for a more evolutionary approach along the battle command migration path.

The Army's recent approval of FusionNet initiatives and direction to the Army CIO to conduct a best of breed to experiment with knowledge management solutions is a good plan. This task should not prevent continued in theater development and feedback that commanders support. Before the Army launches into testing a "joint" system, the Army should coordinate with the joint community or we will only serve to sub-optimize joint service long term effectiveness.

With the entry of JC2 into technical development, the services have a sound start to long term joint command and control system development. Finalizing a unified joint service command and control structure that is allocated service funding and authority will be the critical aspect of success. Aligning subordinate mission capability packages within this structure will serve to direct a much needed unified technical architecture. Of concern will be the inclusion of DISA as a controlling agency. The additional bureaucracy of the structure could create an environment of stagnated decision making when the operational force needs near term solutions.

It is encouraging that FCS software development is included within the Army migration plan but concerning that it may not be linked with the JC2 program plan. The Army probably sees significant adverse risk in placing its command and control modernization plan in joint

program and acquisition structure. The risk of not doing this though is again developing
disparate system capability with the joint community. With a migration plan that expects some
ABCS capability to remain in the force for at least 8 more years, the Army must now split funds
between sustaining ABCS capability, funding JC2 product development efforts, and funding
future command and control software development. While some efficiency may be gained by
migrating and/or consolidating some ABCS capability within the technical concepts of JC2, FCS
ongoing software development will at some point force the Army to choose between full
implementation of FCS software to the detriment of joint software application use. The Army
should seize upon the JC2 development concept to gain leadership position, drive the key
ground force mission capability packages, and potentially unify Army software laboratory effort
with similar facilities and expertise of sister services.

The science of battle command is hard work. It is very difficult to translate a commander's
need to visualize, describe and direct into supporting software requirements. Where the Army
strayed from its desired end state was allowing a bureaucracy of requirements and materiel
developers to continue developing systems optimized for a specific BOS staff element but never
really achieving the integrating capability the commander needed to link the science and art of
battle command. The opportunity exists now to get the science component right. What will be
needed is some risk acceptance that a multi service organization will define and manage the
development of this capability. The Army must support this new organization and ensure that
capability not only develops from concept based requirements but also leverage the immediacy
and expertise of deployed forces. If successful, the Army may want to orient its FCS
development more towards JC2 as its evolutionary command and control path rather than
continuing to build a capability package that may not have any acceptance outside the Army.
The impact of this will be that once again the Army expends efforts building duplicative yet
marginally interoperable battle command capability. The Army cannot afford this and our
soldiers and leaders deserve better.

Endnotes

[1] General Gordon R. Sullivan and Lieutenant Colonel Anthony M. Coroalles, "The Army in
the Information Age," 31 March 1995; available from
http://permanent.access.gpo.gov/lps20460/carlisle-
www.army.mil/usassi/ssipubs/pubs95/armyinfo/armyinfo.pdf; Internet; accessed 1 December
2005, 20, hereafter referred to as Sullivan and Coroalles.

[2] General Gordon R. Sullivan and Lieutenant Colonel James M. Dubik, "Land Warfare In
The 21st Century," February 1993, available from

http://www.strategicstudiesinstitute.army.mil/pubs/display.cfm?pubID=247; internet; accessed 1 December 2005, xv, hereafter referred to as Sullivan and Dubik.

[3] General Sullivan drew this concept from Alvin and Heidi Toffler, *War and Anti-War: Survival at the Dawn of the 21st Century* (Boston: Little Brown and Company, 1993). The five trends were introduced two years earlier in "Land Warfare in the 21st Century, previously referenced. General Sullivan also asserts that the future will differ most from the past with the emergence of simultaneity as the unifying concept in Information Age warfare and changes in the planning environment.

[4] General Gordon R. Sullivan and Colonel James M. Dubik , *Army Digitization Master Plan* (Washington, D.C. Department of the Army, 1995) available from http://www.globalsecurity.org/military/library/report/1995/admp95-adotoc.htm; internet; accessed 15 November 2005.

[5] Peter F. Drucker, "The Coming of the New Organization," *Harvard Business Review* 1(January-February 1988): 46.

[6] Sullivan and Dubik, xxvii

[7] Sullivan and Dubik, xx

[8] Sullivan and Dubik, xx.

[9] The primary systems included within the Army Battle Command System are All Source Analysis System (ASAS), Internal System Control – Version 4 (ISYSCON), Maneuver Control System (MCS), Advanced Field Artillery Tactical Data System (AFATDS), Air and Missile Defense Planning and Control System (AMCPCS), Battle Command Sustainment and Support System (BCS3), Global Command and Control System – Army (GCCS-A), Digital Topographic Support System (DTSS), Force XXI Battle Command Brigade and Below (FBCB2), Integrated Meteorological System (IMETS), and the Tactical Airspace Integration System (TAIS).

[10] A defined purpose of the COP as stated in U.S. Department of the Army, *Operations,* Field Manual 3-0 (Washington, D.C.: U.S. Department of the Army, 14 June 2001), 3-5.

[11] U.S. Department of the Army, *Mission Command: Command and Control of Army Forces,* Field Manual 6-0, (Washington, D.C.: U.S. Department of the Army, August 2003), 1-6, hereafter referred to as FM 6-0.

[12] FM 6-0, 1-9.

[13] FM 6-0, 1-11.

[14] Lieutenant General William S. Wallace, "Network-Enabled Battle Command," Military Review (May – June 2005): 3.

[15] Sullivan and Dubik, xx

[16] FM 6-0, 1-12.

[17] Headquarters Multi-National Corps - Iraq, "Operational Needs Statement (ONS) Supporting XVIII Airborne Corps and Multi-National Corps Iraq Information and Knowledge Management," memorandum for Headquarters, Department of the Army (DAMO-RQ), 400 Army Pentagon, Washington, D.C., undated. Hereafter referred to as XVIII Corps ONS.

[18] Paraphrased from FM 6-0, 1-2.

[19] John P. Stenbit, "DOD Net-Centric Data Strategy," memorandum for DISTRIBUTION, 6000 Defense Pentagon, Washington, D.C., 9 May 2003.

[20] John P. Stenbit, "Horizontal Fusion: Enabling Net-Centric Operations and Warfare," *Crosstalk: The Journal of Defense Software Engineering*, January 2004 [journal on-line]; available from http://www.stsc.hill.af.mil/crosstalk/2004/01/0401Stenbit.html; Internet; accessed 15 November 2005. Mr. Stenbit specified the following areas critical to net-centric transformation. Army Battle Command Systems would be categorized under the Net-Centric Enterprise Service category.

- **The Global Information Grid (GIG) Bandwidth Expansion Program.** Provides a secure, robust, optical Internet protocol terrestrial network.
- **Joint Tactical Radio System.** A family of software-reprogrammable radios based on an open-communication architecture that will provide interoperable, tactical, wideband Internet protocol communications capabilities.
- **Wide-Band Satellite Communications.** Provides ubiquitous communications with optical quality bandwidth to mobile and tactical users.
- **Net-Centric Enterprise Services.** Provides the infrastructure services to support the broad range of applications and data used in a net-centric enterprise.
- **Information Assurance.** Supports all efforts to ensure that the net is robust, reliable, and trusted.
- **Horizontal Fusion.** Net-centric applications and content needed to provide analysts and warfighters with the ability to make sense of complex and ambiguous situations.

[21] General John M. Keene, *The Army Knowledge Management Implementation Plan*, (Washington, D.C.: U.S. Department of the Army, 1 September 2003), Forward, hereafter referred to as the Army Knowledge Management Plan.

[22] Army Knowledge Management Plan, I-3.

[23] Byron Bergeron, *Essentials of Knowledge Management* (Hoboken: John Wiley & Sons, 2003), 8.

[24] Bergeron, 6.

[25] Todd R. Groff and Thomas P. Jones, *Introduction to Knowledge Management: Knowledge Management In Business* (New York: Butterworth-Heinemann, 2003), 20.

[26] MNC-I Assistant Chief of Staff C6 Colonel Timothy A. Kokinda, "Battle Command Knowledge System," information paper in preparation for a 25 May 2005, Commander MNC-I participation in a video teleconference (VTC) with Commander, Combined Arms Center (CAC) and other senior Army leaders to discuss the way ahead for BCKS. The key concepts of the Battle Command Knowledge System (BCKS) reflect the key concepts presented in conceptual

knowledge management texts. The basic concept of BCKS is to provide warfighters with a Web-based collaboration environment to develop and disseminate knowledge within communities of practice. Some of the key concepts in BCKS are as follows:

Knowledge is distinct from information and data. An example of a (hypothetical) piece of data would be that an indirect fire attack occurred in a particular location on 23 April 2005. A (hypothetical) piece of information would be that IDF attacks have decreased by 15% in the past three months. Data and information can be described by facts and figures. Knowledge is higher level, more abstract, conceptual, and experiential. A (hypothetical) example would be that AIF are employing a certain set of TTPs in IDF attacks to reduce the effectiveness of counter-battery radar and that certain friendly TTP's are, in turn, effective in countering this new threat.

Understanding is the clear and complete idea of the nature, significance, or explanation of something. It is a personal, internal power to render experience intelligible by relating specific knowledge to broad concepts.

Organizational Implications:

A community of practice (CoP) is a group of individuals with common interests. The counter-IED community, including CEXC, MEOICC, and EOD teams, would be an example of a CoP in MNC-I.

Structured Professional Forums (SPFs) are one of the key mechanisms that BCKS provides for developing and disseminating knowledge within a community of practice. An SPF is essentially a discussion board, similar in concept to the CavNet solution developed by 1st Calvary Division and continued as MarneNet in 3rd Infantry Division or the discussion boards for Iraqi security forces training teams currently hosted on the Corps portal. BCKS SPFs can be moderated or unmoderated, open to all users or restricted to selected users, disseminated on the Web or via E-mail mailing lists. Conversation threads are searchable and can also be highlighted within a CoP.

Virtual Action Learning Teams (VALTs) and High-Performance Commander/Leader Teams (CLTs) are virtual teams of commanders, other leaders, staff, and subject matter experts that collaborate for real-time or near-real-time learning and problem-solving through text and voice-over-IP (VOIP) chat and by sharing documents such as PowerPoint presentations. Conceptually, VALTs and CLTs are similar to collaborating via IWS, but focus on learning and problem-solving. A VALT is a more ad-hoc, transient structure that might be established around a particular operational situation (such as ensuring the security of the Iraqi Transitional National Assembly) while a CLT is a more permanent structure established around unit-pure or task-organized structures.

[27] Summarized from Bergeron, page 5. The key information management steps are:

Creation and Acquisition: Information is authored internally by knowledge workers, acquired through outsourcing, or purchased from an outside source.

Can be questions to customers, designs, graphics, etc.

Modification: Information is manipulated to meet immediate need of consumer. Data is made it usable by form or fashion.

Use: Information is employed for some purpose. Key issues: usability, accessibility, security, intellectual property, and tracking.

Archiving: Storing in form and format that will survive elements of time.

Transfer: Information that moves from one person to another is a prerequisite for Knowledge Management. Key issues may be cost, security, transfer time.

Translation/Repurposing: Information translated into a form more suitable for a new purpose.

Access: How much access to give workers based on their position in the organization and need to know.

[28] Directorate of eBusiness & Knowledge Management Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (OASD/C3I), *Advancing Knowledge Management in DoD: A Primer for Executives and Practitioners*, no date, 19, available from https://bcks.army.mil/secure/linkedfiles/Knowledge Management_DOD_PRIMER.doc; Internet; accessed 15 November 2005.

[29] Summarized from Groff and Jones, 3.

[30] Chairman of the Joint Chiefs of Staff*, Doctrine for Command, Control, Communications, and Computer (C4) Systems Support to Joint Operations,* Joint Pub 6-0 (Washington, D.C.: The Joint Staff, 30 May 1995), I-4, hereafter referred to as Joint Pub 6-0.

[31] FM 6-0, 1-21.

[32] Major General Peter W. Chiarelli and Major Patrick R. Michaelis, "Winning the Peace: The Requirement for Full Spectrum Operations," Military Review (July-August 2005): 16.

[33] Commander Coalition Task Force - 82, "Integrated Digital Command and Control," memorandum for US Army Deputy Chief of Staff Operations and Plans (G3 Requirements Division), 400 Army Pentagon, Washington, D.C., 15 January 2003.

[34] Major General John R. Vines, Commander 82d Airborne Division, interview by author, 7 October 2002, Fort Bragg, NC.

[35] Major General John R. Vines, Commander 82d Airborne Division, interview by author, 7 October 2002, Fort Bragg, NC. This web based capability became generally known as "TACWEB." As more units deployed into theater, they enhanced their organically funded and maintained web capability. The result over the years is that every Division has their own capability built on different software foundations. Units are unable to query across these databases

[36] Department of the Army, Office of the Deputy Chief of Staff, G-3, "Integrated Digital Command and Control," memorandum for Coalition Task Force – 82, Afghanistan, APO AE 09354, 25 March 2003.

[37] Primary Command and control systems refers to Maneuver Control System (Army – Corps and below) and Command and Control Personal Computer (C2PC).

[38] Derived from personal observation from duty as Product Manager, Maneuver Control System. At this time, MCS consisted of two disparate systems itself. One was a UNIX based capability while the other was a WINDOWS based system. PM MCS was authorized to distribute the WINDOWS version as a "Beta – test" tool prior to production approval. This is the system trained for OIF I. In their train up for deployment, The Army had not yet authorized MCS-Light release. As such, V Corps adopted and the command and control system associated with the Global Command and Control System. This WINDOWS system is the "Command and Control Personal Computer (C2PC)." Hence, the Army introduced into theater units trained to fight on one set of systems but had to interoperate with a higher headquarters on a different set.

[39] Blue Force Tracking (BFT) became the name assigned to Force XXI Battle Command Brigade and Below (FBCB2) when operated over L-Band satellite. Originally designed to operate via a Enhanced Position Location Reporting System (EPLRS), BFT was introduced since the Army could not afford to equip OIF forces with EPLRS. Having talked with commanders that have utilized both the L-Band and EPLRS network, both systems have their advantages. BFT provides theater wide visibility and does not constrain a force operating over large distances to the range of EPLRS (the "EPLRS Cloud"). L-Band bandwith is much smaller than EPLRS and consequently platform updates are more infrequent that near continuous updates of EPLRS. Infrequent updates carry significant disadvantages in urban terrain. For the high OPTEMPO and broad area of operation in OIF I, BFT was the better solution as unit Mobile Subscriber Equipment (MSE) could not maintain continuous network communications.

[40] This assessment is paraphrased from the U.S. Army Combined Arms Center, *On Point, The United States Army In Iraq*, (Fort Leavenworth, KS, Center For Army Lessons Learned), available from http://call.army.mil/products/on-point/ch-7.asp#9 ; Internet; accessed 10 October 2005. Hereafter referred to as "CAC: On Point."

[41] "CAC: On Point."

[42] "CAC: On Point."

[43] Of note was the lack of BFT in Afghanistan. Units were "hand pucked" by staff taking verbal reports from units.

[44] Chiarelli and Michaelis , 15.

[45] Carol Wortman and Robert Pitsko, "PEO C3T KM Assessment Overview," briefing slides with partially scripted commentary\, Fort Monmouth, NJ,   PEO Command, Control, Communications – Tactical (PEO C3T), 24 August 2005. This slide contained the diagram and talking points and further credited the idea to XVIII Airborne Corps Knowledge and Information Management Meeting slides, 10 November 2004,

[46] Carol Wortman and Robert Pitsko, PEO C3T, "PEO C3T Knowledge Management Assessment Overview," briefing slides derived from in-country visit by PEO C3T team August 2205, Fort Monmouth, NJ , 24 August 2005.

[47] FM 6-0, 1-21.

[48] The systems under test were All Source Analysis System – Block II, Internal System Control – Version 4, Maneuver Control System, Advanced Field Artillery Tactical Data System, Air and Missile Defense Planning and Control System, Battle Command Sustainment and Support System, Global Command and Control System – Army, Digital Topographic Support System, Force XXI Battle Command Brigade and Below, Integrated Meteorological System, and the Tactical Airspace Integration System. Each of these systems required different decisions. Some needed merely a materiel release while others required full rate production.

[49] U.S, Office of the Secretary of Defense, Operational Test and Evaluation Directorate, Annual Report to Congress, *Army Battle Command Systems*, 2 November 2005, 45

[50] U.S. Department of the Army, "Army Battle Command Domain," memorandum for DISTRIBUTION, Washington D.C., 20310, 30 November 2005.

[51] CAC: On Point

[52] LTC Matthew Stern, et.al., "III Corps G6 Information Systems Division Operation Iraqi Freedom II," briefing slides, Redmond, WA, Microsoft 2005 Army Tactical Symposium, 15 February 2004.

[53] Stern, "III Corps G6 Information Systems Division Operation Iraqi Freedom II." GIS stands for "Geographic Information Systems." GIS is a technology that is used to view and analyze data from a geographic perspective. The technology is a piece of an organization's overall information system framework. GIS links location to information (such as people to addresses, buildings to parcels, or streets within a network) and layers that information to provide a better understanding of how it all interrelates. One can choose what layers to combine based on purpose.

[54] XVIII Corps ONS.

[55] U.S. Department of the Army (DAMO-SBB), "FusionNet," information paper for DA G3, Washington, D.C., 25 July 2005.

[56] Personal experience serving as Product Manager, Maneuver Control System.

[57] U.S. Multi-National Force – Iraq, "Relationship of the Joint Intelligence Operations Capability – Iraq (JIOC-I) and FusionNet," information paper for DAMI-IM, 22 July 2005.

[58] On 10 November 2004, XVIII Airborne Corps hosted a conference to communicate their command's vision and intent for advanced automated software to support its initiatives. To receive Department of the Army support and for product managers to gain authorization to commit funds for this effort, XVIII Airborne Corps initiated an Operational Needs Statement (ONS). The ONS was ultimately approved 21 October 2005.

[59] Headquarters, Department of the Army, Office of the Deputy Chief of Staff, G-3/5/7, "Operational Needs Statement (ONS) (C3-MNC-I-05-072) Supporting XVIII Airborne Corps, Baghdad, Iraq, APO AE 09342," memorandum for Commander, Multi-National Corps – Iraq/XVIII Airborne Corps, Baghdad, Iraq, APO AE 09342, 21 October 2005.

[60] Ibid.

[61] Authors personal experience and notes. As the Product Manager for Maneuver Control System, the system the the 1st Cavalry Division was supposed to be using for C2, I watched as MCS was all but ignored.

[62] Major General Peter R. Chiarelli, Commander 1st Cavalry Division, interview by author, 7 June 2004, Camp Victory, Baghdad, Iraq.

[63] XVIII Airborne Corps ONS.

[64] This position is summarized from Colonel Robert B. Brown, "Transforming in Peace and War," Military Review (May-June, 2005), 26. The Battle Command Knowledge System is accessible from Army Knowledge Online at https://www.us.army.mil/suite/authenticate.do; Internet; accessed 1 December 2005. This website contains many subordinate knowledge networks such as the unit, leader, and warrior knowledge network. Many leader forums also exist such and CompanyCommand NET and Command NET.

[65] MNC-I Assistant Chief of Staff C6 Colonel Timothy A. Kokinda, "Battle Command Knowledge System," information paper in preparation for a 25 May 2005, Commander MNC-I participation in a video teleconference (VTC) with Commander, Combined Arms Center (CAC) and other senior Army leaders to discuss the way ahead for BCKS..

[66] BG Robert E. Durbin email to LTG James Lovelace, "Guidance From The CSA," August 13 2003. BG Durbin at this time directed DA G8 – Program Analysis and Evaluation. LTG Lovelace was the Director of the Army Staff. The memo outlined the Chief of Staff of the Army's guidance for Battle Command. He directed a top down focus vice a bottom up approach offered by the terrestrial materiel solution found in III Corps and the Stryker Brigade Combat Teams. He further enumerated seven commander's needs and directed stop development of the ABCS suite of software at its current block and redirect all available funding to fielding a system down to brigades. The Commander's Needs specified were:

- Friendly Locations

- Current Enemy Situation (ISR and Intel/FS/AD Sensors)

- Running Estimate (Current Combat Power/Future Combat Power/CCIR/BOS
  Staff estimates)

- Graphic Control Measures

- FRAGOs

- Commander's SITREP

- FS Coordination Measures/Capabilities Overlap

Joint and coalition interoperability, although not on the original seven listed by BG Durbin, was added shortly afterwards. Hence 7+1.

[67] Ibid.

[68] There is not truly a clean delineation between a Brigade and above and brigade and below system as both are found at battalion, brigade and division level.

[69] The Joint Staff, "Blue Force Tracking," memorandum for Vice Chief of Staff, U.S. Army and Assistant Commandant of the Marine Corps, JROCM 161-03, Washington D.C., 20318-8000, 13 August 2003. This memorandum requested the services (Army and USMC) provide an integrated briefing to the Joint Requirements Oversight Council to present a way ahead to converge towards a single capability. Frustrated with the lack of progress one year later, the Vice Chairman of the Joint Chiefs published an additional memorandum. JROCM 163-04 specifically directed which systems and services would lead specific efforts and sought delivery of a converged capability no later than FY2006 or sooner. The second reference is The Joint Staff, "Joint Blue Force Situational Awareness," memorandum for Commander, U.S. Joint Forces Command, Vice Chief of Staff, U.S. Army and Assistant Commandant of the Marine Corps, Washington D.C., 30 August 2004.

[70] Deputy Chief of Staff G-3 LTG James J. Lovelace, Jr., *Battle Command Information System Integration & Migration Plan: Version 1.7.2*, (Washington, D.C.: Department of the Army, 21 November 2005), xiii. This approved Army migration document is extensive, detailing each phase of migration.

[71] COL Stuart A. Whitehead, Director, TRADOC Program Integration Office – Battle Command, "Battle Command Information Systems Migration Plan and ICD [Interface Control Documentation]," briefing slides with notes, U.S. Army Training and Doctrine Command (TRADOC), TPIO – Battle Command, 10 January 2006.

Many acronyms are presented in this chart. Thes e acronyms are clarified below:

GCCS-A-Global Command and Control System-Army

C2PC-Command and Control Personal Computer

MCS-Maneuver Control System

TAIS-Tactical Airspace Information System

AFATDS-Advanced Field Artillery Tactical Data System

AMDPCS-Air and Missile Defense Planning and Control System

BCS3-Battle Command Sustainment and Support System

DCGS-A-Distributed Common Ground Station-Army

IMETS-Integrated Meteorological System

DTSS-Digital Topographical Support System

FBCB2-Force XXI Battle Command Brigade and Below

ISYSCON-Integrated Systems Control

AIS-Army Information Server

PASS-Publish and Subscribe Server

JBC-P-Joint Battle Command – Platform

IDM-T – Information Dissemination Management -Tactical

ABCS-Army Battle Command System

JNN-Joint Network Node

JTCW-Joint Tactical COP Workstation

CPOF-Command Post of the Future

WIN-T-Warfighter Information Network-Tactical

JTRS-Joint Tactical Radio System

[72] Assistant Secretary of Defense for Networks and Information Integration / CIO, "Joint Command and Control (JC2) Capability Acquisition Decision Memorandum (ADM)," memorandum for Secretaries of the Military Departments, Vice Chairman Joint Chiefs of Staff, Commander U.S. Joint Forces Command, Director Defense Information Systems Agency, 8 February 2006.

[73] Observation is based on authors last contact with the FCS program management office. The intent of interoperability would be to share data elements. The issue with this is that each system must have a requirement to share that element and associated funding to build the presentation of the required information. This was a major downfall of ABCS as each system had a minimum set of data that it was required to share with the other. The FCS program office could potentially assume a large obligation to fund current force systems to achieve a minimum level of interoperability until the full FCS capability package is present.